DEPARTMENT
OF
AGRICULTURE
CENTRAL PROVINCES

BULLETIN No. V

# IMPORTED PLOUGHS AND THEIR SATISFACTORY WORKING

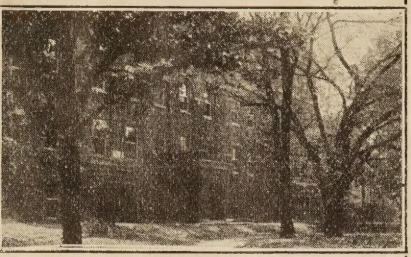
BY

R. G. ALLAN, M.A.,
PRINCIPAL, AGRICULTURAL COLLEGE,
*Nagpur.*



PRINTED AT THE GOVERNMENT PRESS, NAGPUR

Price—Annas Two



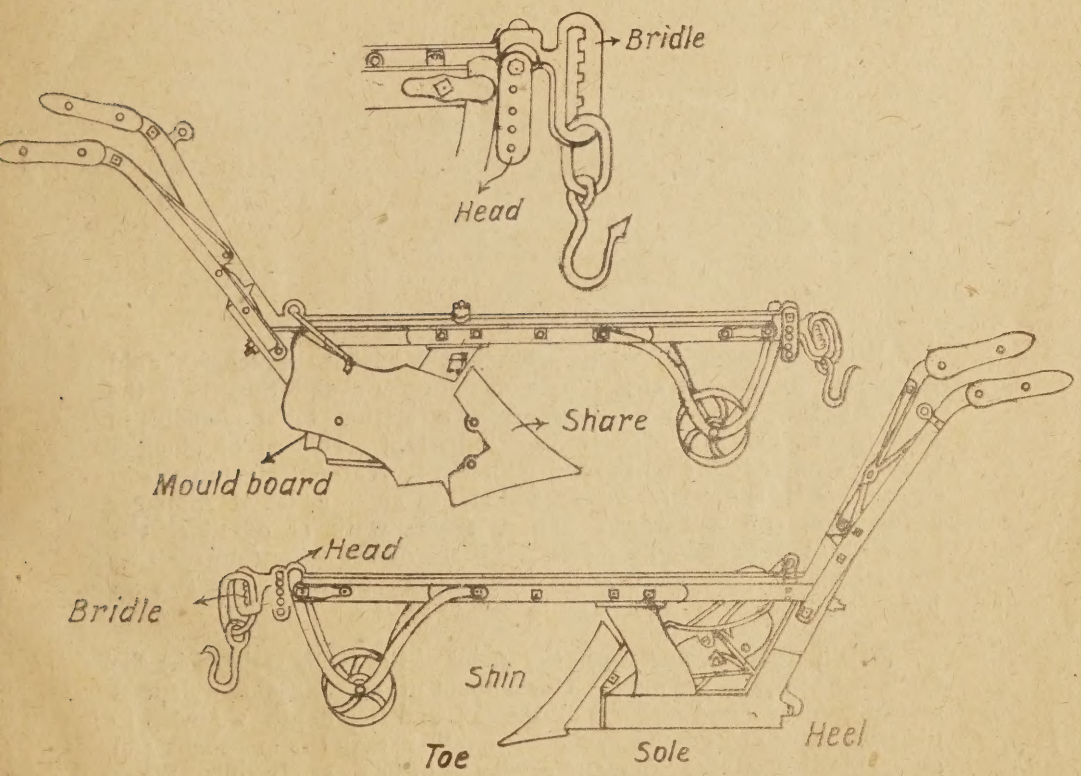
# Imported Ploughs and their Satisfactory Working.

*( By R. G. Allan, M.A., Principal, Agricultural College, Nagpur )*

Imported ploughs and ploughs made in India on similar lines are becoming fairly common in certain parts of the province. Those most commonly in use are Turnwrest ploughs, by different makers, but fashioned on the lines of those of Ransome's and the 'Sabul' made by the latter Firm.

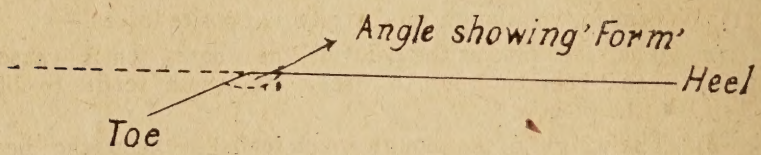
In a great many instances these ploughs are not doing their best work for lack of knowledge on the part of their owners and their ploughmen, as to how the plough should be adjusted to effect this.

This pamphlet is an attempt to explain in simple fashion the principle of the plough and hence its correct handling in the field.



In the first case it is necessary to examine these diagrams, so as to understand what is referred to in the explanation below. The portion the plough rests on is termed the 'sole' or 'foot' of the plough, and the point of the share is termed the 'toe, while at the other end of the sole we have the 'heel.' The point of the share opens the way in the soil which is being ploughed. The share cuts away the soil horizontally, while the shin or front edge of the plough cuts the vertical. The mould board catches this slice cut away from the unploughed soil by the share and the shin and turns it over and partly breaks it.

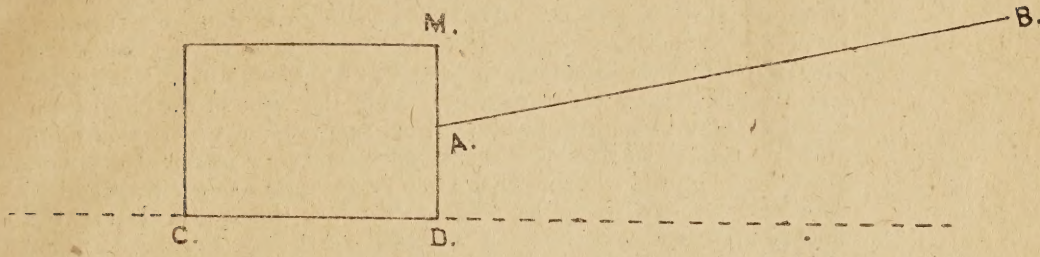
Observation of the lower diagram illustrating the plough from the opposite side to the mould board will show that the sole line from toe to heel is not flat, but that the toe tends to point a little downwards. This tendency not to lie in the same straight line as the rest of the sole and heel is of great importance, specially in hard soils, as it is this which prevents the plough coming out of the soil, when the bullocks begin pulling. This angle between the line of the sole and the line of the share is termed the 'form' or 'pitch' of the plough. The sharper or more noticeable this angle up to a certain point the better is the 'form' of the plough and its capacity to stay in the soil.




When a plough is working properly, the heel of the plough should rest firmly on the soil at the base of the furrow and thus bear the weight of the plough as well as serve as a fulcrum for the handles in guiding the plough. This is most important. Dozens of ploughs can be found working on the toe with the heel 2"—3" above the soil surface. This is entirely wrong, and is the chief cause of difficulty of handling and bad work. Before good work is possible, the plough heel must run on the soil. It is the owner's work to see that his plough is adjusted to get this condition or as nearly this as possible.

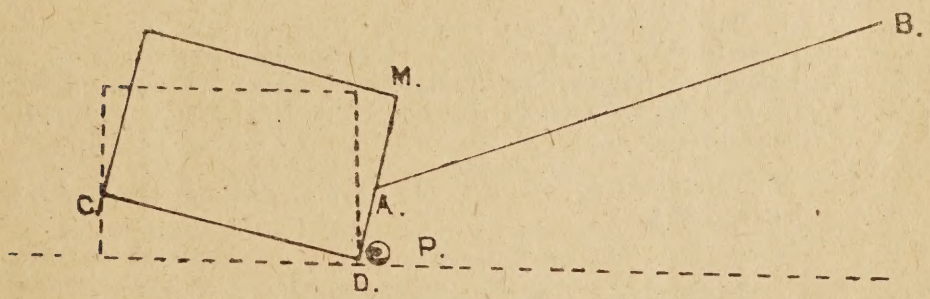
When a plough is at work, the point of the toe is resisted by the earth in which it is working. This amount of resistance will depend on the hardness and stiffness of the soil and the depth we wish to plough. It will be greater in the hot weather than the monsoons and greater in the soil like 'chopan' or clay than in a sandy soil. What is the effect of this resistance to the point or toe on the rest of the

plough? Let us take a simple example. Suppose we have light wooden box, to which we have attached a rope at a point A with the end B over our shoulder.




The sole of this box is C D. C is the heel and D the toe. As long as there is no obstacle on the ground the box slides along with its sole C D on the ground.

But if we were to meet a stone P, which stopped the point D suddenly




we would find that, if we continued to pull, the point C would rise off the ground, and if P did not give way, but held the point D, the empty box would fall over on to its end D M.

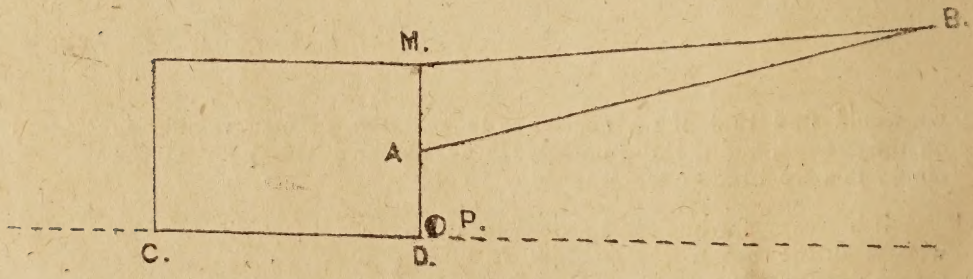
If however our box had stones in it, so that it was heavy, the weight of the box would prevent it turning over, as the weight acting downwards towards the earth would tend to balance the force or resistance at P which was causing the box to turn over. Thus we have a sort of balance at the point D just like that of a balance in a shop. D is the balancing point or turning point, and in one scale of the balance we have the weight of the box and stones and in the other scale pan, the resistance of the body P. The plough is

exactly the same. The point of the share corresponds to D, the resistance of the earth to P, and the weight of the body of the plough to the box and stones.

A plough will not work satisfactorily, if the resistance of the soils in which it is used is greater than the weight of the plough, though a proper construction in a plough with reference to the character of pitch and a suitable 'form' will go a long way towards reducing unnecessary weight. If the resistance of the soil is too great the heel of the plough is bound to be lifted from the ground and, though it may not turn over, as in the case of the light box, it will be very difficult to handle. For this reason when ploughing in hard heavy soil, or for deep work, it is necessary to have a heavier plough than when work is done on light sandy soils and in the monsoon. To get good work in the hot weather in Berar the mould board and body of the plough must be heavy. The Sabul plough is thus not very satisfactory as it lacks weight. Even the Turnwrest plough is at times not sufficiently heavy. Many men who use a plough at this season in these soils would find the work better and easier, if they had a heavier plough. The writer for this reason prefers either the 'Steel Eagle' plough (Ransome) or the heavier make of 'Arlington' (Betcher and Tatlor Chicopea Falls Mass, U.S.A). The actual weight of the plough has not so much influence on the power the bullocks must exert as the resistance of the soil and a heavier easier running plough often causes less strain. It is however possible to adjust the plough, so as to help it to remain level even though the resistance increases.

Turning to the diagram of the plough we will notice a portion in the front of the plough which is called the head. This is a piece which has a series of holes at different heights. The chain, on which the bullocks pull, can be attached to the 'bridle' in any of these holes.

Turn again to our box. In the first diagram the rope A B is fastened at A.



What will be the effect of attaching the rope at M. If attached at M when we strike P the pull in the direction M B will tend to help the box to fall over on side D M more easily. Because we are as it were helping the resistance P to overcome the weight of the box. If however we fasten it low at or near the bottom at the point D, the box will have much less tendency to turn over. This is because by a low point of attachment, we tend to help the weight of the box, not the obstacle P. Indeed if the resistance at P is only slight, we shall probably by fastening our rope at B cause the point D to come up.

Now we have the same state of things at the plough head. If we attach our chain in the top hole we will tend to pull the point or toe downwards, in other words, we will tend to increase the resistance of the soil, and cause the pull of our bullocks to make the heel D come up. If we fasten our chain to the lowest hole, the result will be like fastening the rope at D, we will help the mould board and body of the plough to withstand the resistance of the soil and thus we will have a better chance of keeping the heel on the ground and the plough balanced.

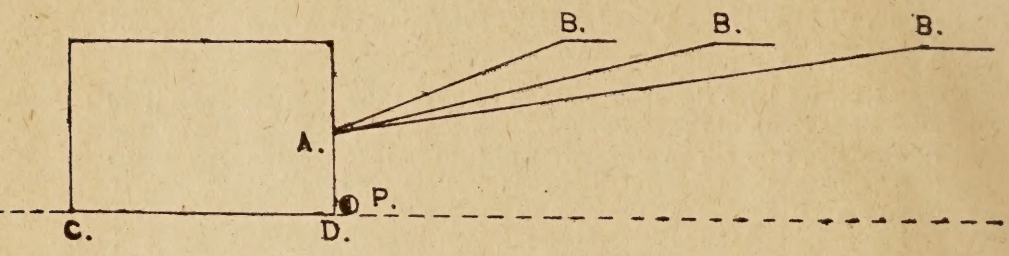
A very common fault in adjusting a plough is always to fasten the chain to the top or upper holes of the head. If we are ploughing in fairly soft soil, when the earth resistance is not great such fastening will no doubt cause our plough to go deeper, and as the plough is fairly heavy, and the resistance is not excessive, the plough will keep level.

When we plough in the hot weather, we meet great resistance. At this season we must help the mould board and weight of the plough to equal this and thus keep the plough balanced or level. This is done by fastening our chain to the lowest or one of the lower holes according to the hardness of the soil.

In the hot weather it is useless to plough much less than 8″ deep. Once we have the point of the share under the hard top crust of soil, there is little or no chance of the plough being pulled out of the ground by fastening the chain to the lowest hole; provided the 'form', referred to earlier, is good. One of the objections to ploughing with an old share is the fact that as the share wears away, it not only gets blunter, but the 'form' gets bad, preventing the plough working correctly. The maximum depth in the hot weather or in dry soil conditions will be regulated chiefly by the wheel of the plough, not by the hole on the T head to which we fasten the chain. The wheel should however be regarded chiefly as a convenience in turning the plough or in transport and as a steadying agent, when the plough is working in varied soils. As far as possible depth even in hot weather conditions should be arrived at by the adjustment of the length of draught chain and the position of hitch. Undue pressure of the wheel on the soil means wasted power.

Another factor which effects the balancing of the plough is the distance from the plough at which the pair of bullocks nearest the plough are yoked.

A return to the box will show this at once.

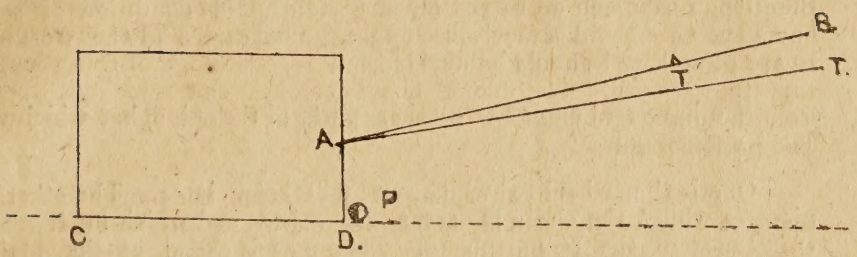



B B' B'' are all the same height above the ground and correspond to the yokes on the bullock necks.

It will be seen that if the yoke is at B' and the line of the chain A B' there will be tendency to lift the point D just as there was, when we fastened the rope at the point D. While if the yoke is out at B'' the opposite will be the case and the point D will be pulled towards the soil. If we meet resistance at P yoking at B' will help the weight of the plough to balance the resistance, but if we yoke at B'' the increased resistance will be assisted and the heel C will be lifted up.

This can be brought into use when we work the plough. By fastening the bullocks near to the plough when the soil is hard, we can help to keep the plough sole level. In practice the yoke of the pair of bullocks next to the plough should lie about $7\frac{1}{2}''$ from the plough head. The first attempts at getting the plough in balance should be made by altering the height of the fastening at the head. If this fails to be effective the chain attaching the bullocks can be reduced in length bringing the bullocks nearer the plough. Too long a trace or draught length means wasted power. The shorter the trace length provided the plough is kept in balance and at the proper depth, the more force can the bullocks exert. On the other hand too short a trace may make the ploughman's handling more difficult. It may be noted here that the bullocks referred to are those about the height of *malwi* bullocks. If small bullocks are used, the length of chain between the head and the yoke must be reduced.

An examination of the diagram below will explain this.




If B equals the yoke point of ordinary bullocks at $7\frac{1}{2}''$ A B is the line of pull. If we fasten smaller bullocks of the height T the draft line with A T, but this draft line is some thing like A B'' in the figure above, which we have seen will cause the point D to go down and C to go up. Hence in order to get the draft with the small pair to be in line of the big pair we must pull them back nearer to plough, *i. e.*, to T' which is on the original line A B.

Let us gather what we have learnt.

(1) Whenever we plough, we have two opposite forces—

(*a*) The resistance at the point of the share, which causes the heel to tend to rise, *i. e.*, which tends to lift the plough.

(*b*) The weight of the plough which tends to keep the heel on the ground unless the resistance is too great.

From this we learn that when the soil is hard or resistant, then the plough body must be heavy in order to balance this.

(2) The makers have arranged a series of holes at the head of the plough to which the chain may be fastened. When the soil is soft and resistance is slight, fastening in the lower holes will tend to pull the point up and make the ploughing shallow. Fastening in the upper holes will cause the plough to go deeper. As the resistance is not great, the weight of the plough will tend to keep the heel on the ground. When the soil is hard and ploughing is deep, fixing the chain in the lower holes will help the balance of the plough and will tend to keep the heel on the ground. If the plough has a good 'form' the point will not be pulled out of the ground. Any fixing of the chain in the top holes is always wrong under these conditions.

(3) The balance of the plough can also be helped by altering the distance of the bullocks from the head of the plough. A normal distance is about $7\frac{1}{2}'$ from the plough head. It is rare that this

distance needs to be increased. In the hot weather as the last effort to secure balance, this distance may be shortened by 6" to one foot. A ploughman not infrequently keeps altering this distance, sometimes having the bullocks close and other times too far off. Once the plough has been corrected for a certain field condition of soil, any altering of the distance must effect the balance and the working of the plough and should be avoided.

We have still one or two other parts of the plough, which we must understand.

One is the wheel to which we will refer later. The other is piece to which the chain is actually attached and which in its turn is fastened to the plough head. This part is called at times 'the bridle'. It varies in character. Sometimes, as in the Turnwrest plough, it is a horizontal strip cut with notches into which the hook to which the chain is to be fixed is fastened; but in every case it is some device whereby the point at which the chain is fastened can be moved horizontally towards or away from the mould board or furrow side of the plough. It must be understood at this point that ploughs are built by their makers to plough between certain depths and to a certain width of furrow. Any attempt to go deeper than the maximum will mean bad work, and any attempt to vary the width of furrow to any very marked extent will be equally bad, though it is less harmful to plough slightly less than the correct width than to try and plough wider. It does however happen at times that a ploughman who is ploughing deep may wish to reduce the width of his furrow slice, so as to save his bullocks or at times he may wish to slightly increase the width. Any undue increase of width by alteration of bridle will tend to the plough to run obliquely to the direction of the furrow and increase draught considerably. Again it may happen that pull exerted by the bullocks walking on the firm soil is better than that of those in the furrow or that one animal is stronger than the other or again (not infrequently the commonest cause) the plough has got a little worn. Any of these causes will tend to cause the plough to go towards the furrow or ploughed land making the furrow slice too narrow or away from the already ploughed area making the furrow too wide. It is under these conditions that we make use of the bridle. If we are ploughing the standard width of furrow and if no cause is tending to make the plough travel towards the furrow or the opposite way, the chain ring is attached in a notch in a straight line with share point of the plough. If we have any reason to increase the width above the standard or if there is any tendency on the part of the plough to go towards the furrow, making the furrow slice less, then the chain is attached in one of the notches in the furrow side of the bridle—dependant on how much we wish to increase the width or the amount of the wrong direction which we wish to neutralize. The further we fix the chain towards the furrow end of the bridle the wider will the furrow become. If the opposite is the case, *i. e.*, we wish to reduce the width, we must then fix the chain in a notch towards the unploughed land side of the

bridle. By the help of the bridle the farmer maintains the width of furrow and assures that the plough runs straight. It is probably better to consider the 'bridle' as a corrective device, when factors exist which tend to cause an undue widening or reduction of width of the furrow, rather than to consider the bridle as a direct method of increasing the width of ploughing under normal conditions.

*Wheel.*

This is called a balancing wheel. This means a wheel which will help to keep the plough balanced once the *adjustments are correctly arranged.* One does not need a wheel, but the presence of the wheel helps the ploughman in his work.

Usually in adjusting a plough the wheel should be raised right out of the way, and when the balance and depth are decided, the wheel can be lowered to help the maintenance of this when working. In soft soil conditions the depth to which a plough works will be got in the first case by raising or lowering the chain in the holes at the head of the plough. The wheel is then lowered to prevent the plough going too deep and this helps to keep the plough level. Though the tendency to run level must have been secured by a proper adjustment of chain in the head and the length of the chain.

In hard soils ploughing must be deep, the adjustment at the head of the plough is principally to get the plough level on its sole. In this condition we may use the wheel to regulate the depth or rather to prevent the depth being too great. Thus once we have the plough fairly balanced we can by the aid of the wheel arrange whether the plough is to keep working at 7″-8″-9″ depth.

The following may be taken as the chief practical points to consider in purchase and working:—

(1) Ploughs are built to meet cerain soil conditions. Select a plough which is constructed to deal easily with worst average conditions under which the buyer is likely to use it.

(2) A plough to be satisfactory in hard soils as for instance the black cotton in the dry season—

(*a*) Must have sufficient weight. This weight should lie in the mould board and body not at the point of the beam.

(*b*) A good 'form'—often neglected but most important.

(*c*) A share which tends to come to a sharp point.

(*d*) And good vertical shin.

In short a plough capable of working 8″ to 9″ on level sole when properly adjusted. In working the selected plough remember that, if the plough has been chosen correctly for the type of work in

view, the plough is capable of running on a flat sole with the land side nearly vertical, if properly adjusted. No plough is doing good work, if it does not do so. Except in the very hardest conditions such a plough once correctly adjusted as regards balance and furrow width should require practically no strain on the part of the ploughman. In fact he should be able to let go the handles, or just touch them for several yards at a time without alteration in the quality of work. Under most soil conditions a boy of 12–14 can handle a properly adjusted plough, while if not adjusted, the strongest man will find himself taxed to control it.

The adjustment needed, as has been indicated, is got by the selection of the proper hole at the plough head and a correct distance of bullocks from the plough together with the use of the right point in the bridle to keep the width of the furrow even.

This correct adjustment is not permanent. A plough must be adjusted for each kind and condition of soil in which it is to be used.

In beginning operations with a new plough or even an old plough under fresh soil conditions.

I.—In the monsoon or when soil resistance is not great—
(1) Raise the wheel.

(2) Fix the draft in the lowest hole and in the notch in the bridle opposite the share point and yoke the bullocks about 7½′ from yoke to plough head.

(3) Commence work and note depth. If insufficient, raise point of attachment at plough head by one hole and continue till the plough penetrates the depth required. Then lower wheel till it touches the soil.

(4) If the plough tends to incline to right or left, adjust chain hook along the bridle in the direction to which the plough tends to go, till a straight tendency is produced.

II.—In the dry weather or when the soil is hard. In this case ploughing is rarely possible unless at least 7″ depth is attainable.

(1) Raise wheel.

(2) Attach wheel at central hole or plough head, and at a point on the bridle opposite the share point, yoking bullocks as before.

(3) Commence work and note the tendency of heel to keep to or leave the ground. If the sole is not running on the furrow bottom, attach chain to a lower hole in the head. Continue to lower attachment point till the plough does run level. If this is not sufficient, reduce length of draught chain bringing the bullock nearer to the

plough. About 6½' is the minimum distance. If this is ineffective, the plough is too light for the character of soil and depth required, or the hitch is defective.

(4) Assuming adjustments have had the desired result, lower the wheel till the correct depth, as measured by the distance of wheel base to plough sole, level is obtained.

An alternative method to points 3—4 above is to adjust the balance of the plough by the means indicated for the maximum depth at which it is known to plough and, if this is reached without an undue reduction of the trace length, to reduce the depth to that desired for the work by reducing the length of the trace, till this is effected, lowering the wheel to maintain this depth and steady the plough.

(5) Regulate position along 'bridle' till the plough runs straight as in monsoon conditions.

In working with 2 or more pairs it will be found advisable to hitch all pairs except those nearest the plough to the lowest hole regulating the point of hitch of the rear pair according to soil conditions.

Govt. Press, Nagpur t—No. 1171, Dir. of Agri.—18-9-19—500.